

1987 Wheat Disease Survey Results Indicate Disease Potential for '88

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The primary economic leafspot disease organism of wheat in North Dakota for the past 20 years has been tanspot (*Pyrenophora tritici-repentis*). However, other leafspot fungi were present too, causing slight to severe damage. These included the spot blotch fungus, *Helminthosporium sativum*, and Septoria leaf blotch caused by *Septoria avenae* f. sp. *triticea*. From 1967 to 1975, *S. avenae* f. sp. *triticea* caused leaf spot damage second only to tanspot. Another Septoria leafspotter, *Septoria tritici*, was confirmed in North Dakota for the first time in 1985 and 1986 on lower leaves of winter wheat (personal observation of Robert Hosford), with unconfirmed reports of occurrence in 1986 on upper leaves of spring wheat. A third Septoria species, *Septoria nodorum*, has been present at low levels, causing slight to moderate damage from 1967 to 1986 on wheat leaves throughout the state (1).

Fungal leaf and head diseases were widespread and severe on all wheat classes in large areas of North Dakota in 1986, and contributed to substantially reduced yields, low test weights and poorer market grades.

The major leaf and/or head diseases contributing to these wheat losses in 1986 were tanspot, leaf rust (*Puccinia recondita*), head scab (*Fusarium graminearum*), Septoria leaf blotch (a complex of the three Septoria species mentioned above), and Septoria glume blotch (*S. nodorum*).

Septoria nodorum has caused serious glume blotch for many years in several areas of the world. In 1986 it was confirmed to be causing glume blotch in North Dakota for the first time (2). Glume blotch occurred primarily in the northeastern part of the state and primarily, but not exclusively, on durum. This fungus contributed to severe shriveling of kernels, severe yield reductions and very low test weights.

In 1986, head scab was severe throughout the Red River Valley on hard red spring wheats and durum, causing severe test weight reductions. Leaf rust severity varied from year to year, depending on weather patterns, movement of rust spores into the state from states to the south of North Dakota, and the susceptibility or resistance of cultivars grown. Leaf rust was common on some varieties in 1986.

Humid weather and shifts in cropping and tillage practices may have accounted for increased leaf and head diseases and a possible shift in predominant organisms in 1986. All

of the above mentioned fungal diseases, except for leaf rust, overwinter in North Dakota and survive on wheat stubble. The destruction caused by these fungal diseases warranted an improved understanding of the occurrence and distribution of these organisms.

Because of the high disease levels in 1986 and the overwintering capability of many fungi, there was a high potential for serious disease damage in 1987. A wheat disease survey was undertaken in 1987 to assess the presence, distribution, incidence and severity of the diseases caused by leaf and head disease organisms.

METHODS OF SURVEY

The 1987 wheat disease survey and data analysis was conducted on a statewide basis with 44 counties and 316 fields surveyed. Field survey work was conducted primarily during June and July, until the crop became too mature to estimate damage to leaves.

Data collected for each field visited included: date, county, legal description, wheat class, growth stage, diseases observed, disease incidence (number of tillers or heads affected), severity (based on average percent leaf area or head area affected), highest leaf affected, and rust reactions. If possible, the variety, previous crop and tillage method were also recorded. The survey emphasized fungal leaf and head diseases, but observations of viral, bacterial and root diseases were also recorded. Samples of the leaves and heads were frequently collected for subsequent laboratory diagnosis and disease confirmation. Disease diagnoses in the field and laboratory were made by R.W. Stover.

1987 RESULTS

The counties and number of fields surveyed are given in Figure 1. The northeastern counties had the greatest number of fields surveyed (Table 1). The survey was more concentrated in the northeast because of the higher rainfall received in that area, severe disease there the previous year, and the slower maturation of the crop in that district, allowing time to survey, compared to many southern counties. Survey work was least frequent in western areas of the state, in part because of the generally lower disease development there in 1986, but also because of budget and time constraints.

The wheat leaf diseases most frequently observed statewide in 1987 were tanspot (observed in 60 percent of the fields), leaf rust (in 56 percent of the fields), spot blotch

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(in 22 percent of the fields), and *Septoria nodorum* leaf spotting (in 18 percent of the fields) (Table 1).

In an attempt to evaluate the relative importance of each leaf disease in causing yield and quality losses, a field impact factor (FIF) for each field was calculated by using the following formula:

$$\text{FIF} = \frac{\text{incidence} \times \text{severity}}{\text{Zadok's growth stage}}$$

Incidence = the average percent of infected tillers.

Severity = the average percent of leaf area affected of the entire plant.

Zadok's growth stage = a 0 to 99 scale for designating small grain growth stages.

Division by the Zadok growth stage value is an attempt to allow comparison of observations made at different growth stages. Plants infected at an early growth stage **may** suffer more damage than plants infected at a later stage. However,

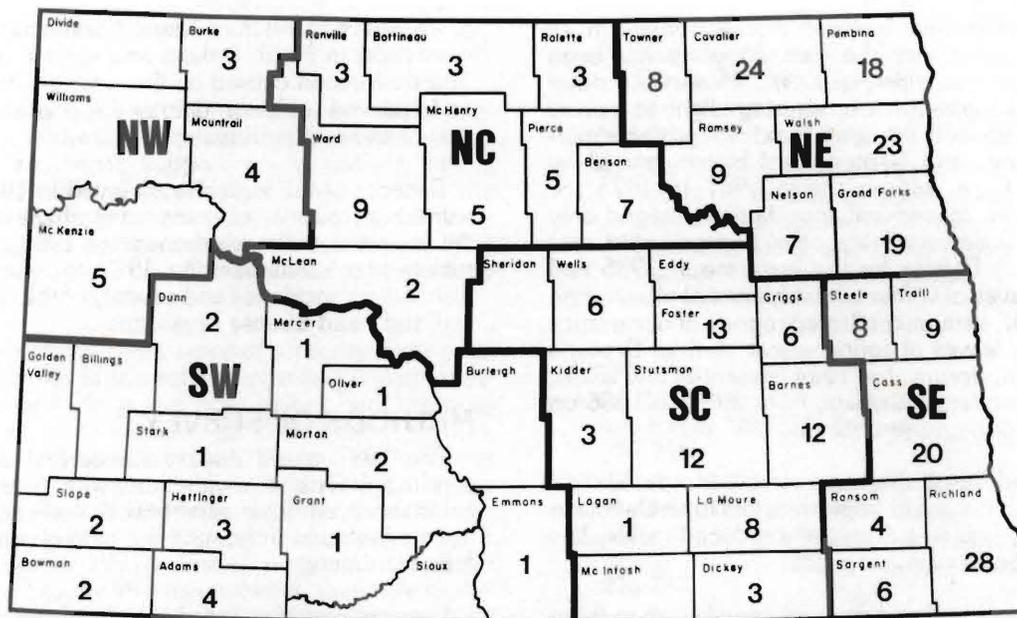


Figure 1. Number of North Dakota Wheat Fields Surveyed for Diseases by County, 1987.

Table 1. Percentage of North Dakota fields infected with major leaf diseases in 1987.^a

| Disease | District | | | | | | Statewide |
|--|---------------------------|------------|---------------|---------------|------------|------------|-----------|
| | North-east | South-east | North Central | South Central | North-west | South-west | |
| | Number of Fields Surveyed | | | | | | |
| | 108 | 75 | 37 | 64 | 12 | 20 | 316 |
| | Percent Fields Infected | | | | | | |
| Tanspot | 47 | 72 | 51 | 64 | 58 | 17 | 60 |
| Leaf Rust | 54 | 77 | 14 | 81 | 0 | 20 | 56 |
| Spot Blotch | 41 | 11 | 22 | 13 | 8 | 0 | 22 |
| <i>Septoria nodorum</i> blotch | 29 | 1 | 41 | 8 | 33 | 0 | 18 |
| <i>Septoria avenae triticea</i> blotch | 23 | 7 | 8 | 11 | 0 | 5 | 13 |
| <i>Septoria tritici</i> blotch | 18 | 5 | 0 | 5 | 0 | 0 | 8 |

^aFusarium head scab and septoria glume blotch were found in 19 and 15 percent, respectively, of the post-flowering fields surveyed.

if a disease is present early in the season (low Zadok number) and does not progress during the growing season, division by this Zadok number could give an erroneously high FIF value. FIF comparisons were used only for leaf diseases with similar evaluation methods. Comparison of leaf diseases with root or head diseases was inappropriate, because different severity scales were used.

Statewide, the FIF analysis indicated that tanspot was the most damaging leaf disease, followed by leaf rust, and then *Septoria nodorum* leaf blotch (Table 2). The *Septoria* disease complex (three species) as a whole was more damaging than leaf rust. In certain districts, tanspot was not the most damaging disease. For example, in the north central district, *Septoria nodorum* was the most damaging to the wheat crop. The *Septoria* complex was more damaging than tanspot in both the northeast and north central regions. In the southeast, leaf rust was almost as damaging to the wheat crops as tanspot. Spot blotch, which was found frequently on wheat (Table 1), had a very low FIF value statewide (Table 2) because of its relatively low severity.

Differences in FIF values also occurred among the classes of wheats. In durums, the most damaging disease in 1987 was due to *Septoria nodorum*; in spring wheats and winter wheats the most damaging disease was tanspot (Table 3).

Table 4 presents FIF values generated only from fields in which the disease was found. For example, *Septoria tritici* in spring wheat was quite severe in the fields where it was found. Because it was found in only 8 percent of the spring and winter wheat fields surveyed, which resulted in low FIF values (Tables 1, 2, and 3), its economic importance in the state was relatively low.

In North Dakota *Fusarium* head scab was found in 19 percent of the post-flowering fields, 23 fields of hard red spring wheat and one field of durum. Glume blotch (primarily *Septoria nodorum*) was found in 15 percent of the post-flowering fields, six durum fields and 13 hard red spring wheat fields. *Fusarium* head scab was found primarily in northeastern North Dakota, with two observations in south-

Table 3. Average field impact factor (FIF) of major wheat leaf diseases in North Dakota by wheat class, 1987.

| Disease | Durum | Spring wheat | Winter wheat |
|--|------------------|--------------|--------------|
| | Number of Fields | | |
| | 43 | 211 | 52 |
| | -----FIF----- | | |
| Tanspot | 2.3 | 10.8 | 9.8 |
| Leaf Rust | 0.003 | 5.6 | 2.1 |
| Spot Blotch | 1.0 | 0.8 | 0.02 |
| <i>Septoria nodorum</i> blotch | 11.2 | 2.6 | 0.1 |
| <i>Septoria avenae triticea</i> blotch | 4.0 | 2.7 | 1.1 |
| <i>Septoria tritici</i> blotch | 0 | 2.9 | 1.1 |
| <i>Septoria</i> complex | 15.2 | 7.9 | 3.1 |

eastern North Dakota. Glume blotch was found in northeastern and north central North Dakota. *Septoria avenae* f. sp. *triticea*, a common cause of leaf blotching in North Dakota, was found as a minor participant in glume blotch, the first reported case in the world of this fungus being associated with glume blotch.

DISCUSSION - DISEASE POTENTIAL FOR 1988

Of the diseases reported, all, except leaf rust, overwinter on wheat stubble in North Dakota. The potential for damage to the 1988 crop is believed high, based on the survivability of these fungi and their abundance in 1987. The occurrence and severity of these diseases in 1988 will primarily depend on favorable environment for their infection and spread. All

Table 2. Average field impact factor (FIF) of wheat leaf diseases in North Dakota in 1987.

| Disease | District | | | | | | Statewide |
|--|---------------------------|------------|---------------|---------------|------------|------------|-----------|
| | North-east | South-east | North Central | South Central | North-west | South-west | |
| | Number of Fields Surveyed | | | | | | |
| | 108 | 75 | 37 | 64 | 12 | 20 | 316 |
| | -----FIF----- | | | | | | |
| Tanspot | 11.5 | 5.0 | 2.2 | 12.7 | 3.7 | 18.4 | 9.3 |
| Leaf Rust | 5.3 | 4.1 | 2.2 | 5.2 | 0 | 0 | 4.1 |
| Spot Blotch | 1.8 | 0 | 0.7 | 0 | 0 | 0 | 0.7 |
| <i>Septoria nodorum</i> blotch | 8.5 | 0.03 | 4.3 | 0.1 | 1.7 | 0 | 3.5 |
| <i>Septoria avenae triticea</i> blotch | 5.9 | 0.8 | 3.6 | 0.4 | 0 | 0 | 1.6 |
| <i>Septoria tritici</i> blotch | 5.6 | 0 | 0 | 0.3 | 0 | 0 | 2.0 |
| <i>Septoria</i> complex | 19.1 | 0.9 | 6.7 | 1.2 | 1.7 | 0 | 7.9 |

Table 4. Average Field Impact Factor (FIF) of Wheat Leaf Diseases in North Dakota in 1987 in fields where the disease was present.

| Disease | Durum wheat | Spring wheat | Winter wheat |
|--|---------------|--------------|--------------|
| | -----FIF----- | | |
| Tanspot | 6.2 | 19.2 | 11.8 |
| Leaf Rust | 0.02 | 8.9 | 3.2 |
| Spot Blotch | 2.4 | 3.6 | 0.4 |
| <i>Septoria nodorum</i> blotch | 23.0 | 16.9 | 2.3 |
| <i>Septoria avenae triticea</i> blotch | 34.3 | 20.3 | 9.2 |
| <i>Septoria tritici</i> blotch* | 0 | 33.4 | 7.3 |
| Septoria Complex | 25.2 | 24.8 | 8.8 |
| Bacterial Leaf Blight* | 21.8 | 24.4 | 0 |
| Barley Yellow Dwarf* | 0 | 2.2 | 0 |
| Powdery Mildew* | 0 | 0 | 9.1 |
| Wheat Streak* | 0.9 | 0.9 | 0 |

*Found in a low number of fields.

are favored by warm, wet weather, and damage is often the severest if this environment occurs at heading and through grain filling.

MANAGEMENT STEPS TO REDUCE RISKS OF THESE LEAF AND HEAD DISEASES

Factors that may affect whether these diseases will be a threat to a wheat field in 1988 are: timeliness of planting, rotation choices, variety selection, and tillage practices.

Early planting generally means earlier maturity of the wheat crop, which in turn reduces the risk of exposure to high numbers of disease organisms that build up during the growing season.

Good rotation, planting wheat on previous row crop ground, fallow, or on ground of previous other small grains, reduces the risk of infection from disease organisms that survive in wheat stubble. However, some of these wheat

disease-causing organisms also attack and survive on other small grains. *Septoria avenae triticea* also attacks barley and *Helminthosporium sativum* attacks several small grains.

Good variety selection means choosing varieties that are adapted for the area and which have the maximum disease tolerance or resistance that is available. Planting different fields at different dates to different varieties of varying plant heights and maturities also is recommended to hedge against losses from disease, drought, flood, hail, etc.

Choice of tillage practice affects the amount of wheat stubble present on the soil surface. Stubble is most likely to be a source of tanspot, *Septoria* or scab. Any incorporation of wheat stubble prior to planting reduces, to some degree, the disease potential.

SURVEY PLANS - 1988

A similar disease survey is planned for 1988. Because of budget and time constraints, this survey may not be statewide, but limited to districts having the highest disease incidence in 1987. A statewide survey done by one individual limits repeat visits to a given field and tracking of disease progress. Since 1981, crop disease survey work in North Dakota has been limited because of funding constraints. The Animal and Plant Health Inspection Service (APHIS) had a survey plant pathologist position in North Dakota, but this position was terminated in 1981.

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